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EXAMINER
PAREKH, NITIN

ART UNIT	PAPER NUMBER
2811	

DATE MAILED: 06/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/473,305	FRUTSCHY ET AL.	
	Examiner	Art Unit	
	Nitin Parekh	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 March 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4,12-16,28,32 and 33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4,12-16,28,32 and 33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12-28-99* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 2, 4 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buschbom (US Pat. 5834335) in view of the admitted prior art (APA), Hembree et al. (US Pat. 5931685) and Scholz (US Pat. 5329423).

Regarding claim 1, Buschbom discloses a microelectronic component assembly/package (27 in Fig. 3) comprising:

- an integrated circuit (IC)/microelectronic device substrate/package having a first and second surfaces (IC 16 in Fig. 3) and the first surface including ball grid array (BGA) contacts/pads and terminals/solder balls (contacts/pads not shown by a numerical reference in Fig. 3; see conventional contacts 214 in Fig. 5 of APA)

- a printed circuit board (PCB) substrate (PCB 12 in Fig. 3) having a first and second surface and including pads/contacts on the first surface (20 in Fig. 3; Col. 3, line 5; Col. 4, line 44)
- solder balls (28 in Fig. 3) extending between the IC substrate and PCB contacts where the solder balls are attached to the respective contacts/pads (Fig. 3; Col. 3, line 28), and
- a compression mechanism/support structure for imparting pressure between the substrate and the PCB (23 in Fig. 3; Col. 3, line 45)
(Fig. 3; Col. 2, line 57- Col. 4, line 51).

Buschbom fails to specify:
a) the PCB substrate being a motherboard, and
b) at least one of at least one substrate contact and motherboard contact being recessed having a semispherical surface which is substantially the same radius as that of the solder ball.

a) However, motherboard is a PCB which is used for specific functions. Buschbom's non-reflow contact structure covers generic applications of an electrical connection between the IC and other substrates such as a PWB, circuit board, multichip module, sub-assembly, etc (Col. 2 and 5).

APA teaches attaching microelectronic devices to conventional carrier/substrates such as motherboard (pp. 1-3; Fig. 5), expansion card, etc.

b) Hembree et al. teach forming non-reflow solder ball contact comprising a flat pad (42A in Fig. 3A) or a recess defined by vertical sidewalls (40 in Fig. 3; Col. 5, line 40; Col. 5-8) extending into the substrate (26 in Fig. 3) and conductive material (42 in Fig. 3) layered in the recess (Fig. 3-3E; Fig. 6A-10A).

Hembree et al. further teach selecting the size, shape (circular, oval, square, etc.), dimensions, etc. of the recess including the conductive material (40 /42 in Fig. 3) and diameter of the bump/ball such that the electrical contact within the recess can be accomplished to compensate for the variation in the in the diameter/shape of the bump/ball with minimal bump deformation (Col. 5, line 39-66). Furthermore, Hembree et al show the recess (Fig. 10A) where the width of the recess is substantially same as a diameter of the solder ball and the void is formed in the recess (Col. 9, line 30).

Scholz teaches forming the bumps/balls and recesses (24/28 in Fig. 1) interchangeably on IC substrate and PCB substrate respectively (10/12 in Fig. 1) or those (58/62 in Fig. 3) on PCB substrate and IC substrate respectively (52/46 in Fig. 3) to achieve the desired yield and defect level in fabrication (Col. 3 and 5).

Furthermore, the determination of parameters such as radius of the solder ball, shape/size/profile of the recess, thickness of the liner/conductive material, etc. in chip packaging and interconnection technology art is a subject of routine experimentation

and optimization to achieve the desired alignment, connection/fit and overall package/ dimension ground rules.

It would have been obvious to the person of ordinary skill in the art at the time invention was made to incorporate the PCB substrate being a motherboard as taught by APA and at least one of at least one substrate contact and motherboard contact being recessed having a semispherical surface which is substantially the same radius as a that of the solder ball as taught by Hembree et al. and Scholz so that the surface connection area can be increased and coupling between the contacts can be improved in Buschbom's assembly.

Regarding claim 2, Buschbom teaches substantially the entire claimed structure as applied to claim 1 above, including the substrate comprising a microelectronic device package (IC 16 in Fig. 3).

Regarding claim 4, Buschbom teaches substantially the entire claimed structure as applied to claim 1 above, including the substrate comprising a microelectronic device (IC 16 in Fig. 3).

Regarding claim 12, Buschbom teaches substantially the entire claimed structure as applied to claim 1 above, including the compression mechanism comprising the support structure for imparting pressure between the substrate and the PCB (23 in Fig. 3; Col. 3, line 45).

3. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buschbom (US Pat. 5834335), APA, Hembree et al. (US Pat. 5931685) and Scholz (US Pat. 5329423) as applied to claims 1 and 12 above, and further in view of Domadia et al. (US Pat. 5949137).

Regarding claim 13, Buschbom teaches substantially the entire claimed structure as applied to claim 1 above, and further discloses the compression mechanism/support structure comprising a composite frame/heat sink plate/heat slug surrounding the IC substrate (18/30 in Fig. 1 and 3; Col. 3) and retention devices comprising anchors but fails to specify using a backing plate abutting the second surface with a plurality of retention devices.

APA (Fig. 5; specification pages 1-3) discloses a conventional compression mechanism/support structure comprising:

- a frame (244 in Fig. 5) surrounding the substrate
- a backing plate (246 in Fig. 5) abutting the motherboard

- a thermal plate (248 in Fig. 5) extending over the frame and adjacent the substrate second surface, and

- a plurality of retention devices (252/254 in Fig. 5) comprising a plurality of bolts and nuts extending through the backing plate, frame and thermal plate.

Domadia et al. teach using a support structure where the plurality of retention devices having a plurality of conventional bolts (bolt 46 in Fig. 5 and 7) extending through the back of the substrate, stiffener/frame portion and thermal plate/heat dissipater (Fig. 5-7; Col. 4, line 40-Col. 6, line 48).

It would have been obvious to the person of ordinary skill in the art at the time invention was made to incorporate the backing plate abutting the second surface with a plurality of retention devices as taught by APA and Domadia et al. so that the desired force/pressure level can be achieved in Hembree et al., Scholz and Buschbom's assembly.

Regarding claim 14, Buschbom teaches substantially the entire claimed structure as applied to claims 1 and 13 above, including the plurality of retention device comprising the plurality of bolts, each bolt having a retaining nut (APA: 252/254 in Fig. 5; Domadia et al.: Fig. 5-7; Col. 4, line 40-Col. 6, line 48).

4. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buschbom (US Pat. 5834335), APA, Hembree et al. (US Pat. 5931685) and Scholz (US Pat. 5329423) as applied to claims 1 and 12 above, and further in view of Gililand et al. (US Pat. 6137161).

Regarding claim 15, Buschbom teaches substantially the entire claimed structure as applied to claims 1 and 12 above, and further teaches an interposer substrate (14 in Fig. 1) having a first and second surfaces and the surfaces including contacts/terminals (24/28 in Fig. 1) having the (IC)/microelectronic device being in electrical contact with the first surface of the interposer (Col. 2, line 53- Col. 4, line 18) but fails to disclose at least one solder ball being attached to the interposer and the PCB/motherboard first surface.

Gililand et al. teach using a microelectronic component assembly/package comprising an interposer between an IC and a PWB (12 and 18 respectively in Fig. 1) where the interposer has pads/contacts (25, 22, etc. in Fig. 1) and solder balls (28, 24, etc. in Fig. 1) on both surfaces which are being attached to the respective pads/contacts on the PWB and the IC (Col. 2, line 25- Col. 3, line 45).

It would have been obvious to the person of ordinary skill in the art at the time invention was made to incorporate the interposer having at least one solder ball being attached between the first contact surface and the motherboard first surface as taught by Gililand et al. so that the connection at the desired substrate surface can be

achieved and the grounding/signal connection can be improved in APA and Gililand et al's substrate structures in APA and Hembree et al., Scholz and Buschbom's assembly.

5. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buschbom (US Pat. 5834335), APA, Hembree et al. (US Pat. 5931685) and Scholz (US Pat. 5329423) as applied to claims 1, 12 and 15 above, and further in view of Gililand et al. (US Pat. 6137161), Domadia et al. (US Pat. 5949137) and Hembree (US Pat. 5783461).

Regarding claim 15, Buschbom teaches substantially the entire claimed structure as applied to claims 1 and 12 above, except using:

a) a backing plate abutting the second surface with a plurality of retention devices, and

b) a resilient spacer extending between the thermal plate and the interposer substrate.

a) APA (Fig. 5; specification pages 1-3) discloses a conventional compression mechanism/support structure comprising:

- a frame (244 in Fig. 5) surrounding the substrate
- a backing plate (246 in Fig. 5) abutting the motherboard
- a thermal plate (248 in Fig. 5) extending over the frame and adjacent the substrate second surface, and

- a plurality of retention devices (252/254 in Fig. 5) comprising a plurality of bolts and nuts extending through the backing plate, frame and thermal plate.

Domadia et al. teach using a support structure where the plurality of retention devices extending through the back of the substrate, stiffener/frame portion and thermal plate/heat dissipater (Fig. 5-7; Col. 4, line 40-Col. 6, line 48).

b) Hembree teaches using a resilient elastomeric spacer ring/washer spring (22 in Fig. 2; Col. 4, line 4) extending between the thermal plate and the microelectronic device/interposer substrate to enhance the support/compression mechanism.

It would have been obvious to the person of ordinary skill in the art at the time invention was made to incorporate the backing plate abutting the second surface with a plurality of retention devices as taught by APA and Domadia et al. and the resilient spacer extending between the thermal plate and the interposer substrate as taught by Hembree so that the desired force/pressure and spacing between the substrates can be achieved in Hembree et al., Scholz and Buschbom's assembly.

6. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fjelstad et al. (US Pat. 5812378).

Regarding claim 28, Fjelstad et al. disclose a structure comprising a substrate contact between an IC substrate (68 in Fig. 5 and 6) and a multilayered circuit board substrate (21 in Fig. 5 and 6; Col. 9, line 60) for forming a non-reflow electrical contact (70/42 in Fig. 5 and 6) with a solder/metal ball/bump (70/78 in Fig. 5; Col. 12, lines 43-52) comprising:

- a recess/hole (36 in Fig. 5 and 6) defined by in the substrate by a surface extending into the substrate, and

- a conductive material/contact projection (45/42 in Fig. 5 and 6) layered over the recess forming a void (36 in Fig. 5 and 6) there between, the conductive material/contact projection contacting a portion of the semispherical surface of the solder/metal ball (Fig. 5 and 6; Col. 12, line 27- Col. 13, line 20).

Fjelstad et al. fail to teach the conductive material forming the semispherical surface which substantially conforms to the surface of the solder ball.

However, Fjelstad et al. further teach other embodiments having a variety of configurations/patterns of the conductive material/contact projection (Fig. 4-18; Col. 12-21) including an embodiment in Fig. 18 where the conductive material/contact projection (742 in Fig. 18) has two portions of semispherical surface substantially conforming and contacting the bottom surface of the solder/metal ball (Col. 21, lines 15-26).

It would have been obvious to the person of ordinary skill in the art at the time invention was made to incorporate the conductive material forming the semispherical

surface which substantially conforms to the surface of the solder ball so that the contact area between the solder ball and the conductive lead can be increased in Fjelstad et al's assembly.

7. Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hembree et al. (US Pat. 5931685) in view of Scholz (US Pat. 5329423).

Regarding claim 32, Hembree et al. disclose a variety of non-reflow solder ball contact structures comprising:
- a recess defined by vertical sidewalls (40 in Fig. 3; Col. 5, line 40; Col. 5-8) extending into the substrate (26 in Fig. 3)
- a conductive material comprising plated metal (42 in Fig. 6A) and solder (12, 12A/B, etc. in Fig. 6A) layered/formed in and over the recess (Fig. 6A).

Hembree et al fail. to specify the recess being semispherical in shape and a radius of the upper surface of the conductive material being substantially same as that of the solder ball.

However, Hembree et al. further teach selecting the size, shape (circular, oval, square, etc.), dimensions, etc. of the recess including the conductive material (40 /42 in Fig. 3) and diameter of the bump/ball such that the electrical contact within the recess can be accomplished to compensate for the variation in the in the diameter/shape of the

bump/ball with minimal bump deformation (Col. 5, line 39-66). Hembree et al. show the recess (Fig. 10A) where the radius/width of the upper surface in the recess is substantially same as a radius/diameter of the solder ball (Col. 9, line 30).

Scholz teaches forming the bumps and recesses in the substrates (24/26/58/60 and 28/30/62/64 respectively in Fig. 1/2 and 3/4) where conductive material (38/40 and 58/66 respectively in Fig. 1/2 and 3/4) layered over the recess and the recesses having semispherical or trapezoidal shape are dimensioned to fit the radius/curvature of the tip portion of the contact bumps (Col. 4, line 20-65) and to provide the desired alignment.

Furthermore, the determination of parameters such as radius of the solder ball, shape/size/profile of the recess, thickness of the liner/conductive material, etc. in chip packaging and interconnection technology art is a subject of routine experimentation and optimization to achieve the desired alignment, connection/fit and overall package/ dimension ground rules.

It would have been obvious to the person of ordinary skill in the art at the time invention was made to select the recess being semispherical in shape and the radius of the upper surface of the conductive material being substantially same as that of the solder ball as taught by Scholz so that the surface connection area and alignment can be improved in Hembree et al's substrate.

Regarding claim 33, Hembree et al. teach substantially the entire claimed structure as applied to claim 32 above, and further teach using a resilient/elastomeric material (48 in Fig. 3D) disposed between the substrate and the conductive material layer to improve the cushion effect for the substrate contact (Col. 8, line 15-34).

Response to Arguments

8. Applicant's arguments filed on 03-24-03 have been fully considered but they are not persuasive.

A. Applicant contends that there is no teaching in Hembree et al. about the radius of the solder ball matching that of the recessed contact.

However, as explained above, Hembree et al. teach selecting the size, shape (circular, oval, square, etc.), dimensions, etc. of the recess including the conductive material (40 /42 in Fig. 3) and diameter of the bump/ball such that the electrical contact within the recess can be accomplished to compensate for the variation in the diameter/shape of the bump/ball with minimal bump deformation (Col. 5, line 39-66). Furthermore, Hembree et al show the recess (Fig. 10A) where the width of the recess is substantially same as a diameter of the solder ball.

B. Applicant contends that there is no proper motivation to combine the references.

However, as explained above, the combination of references is applied to achieve increased contacting surface area and improved coupling between the substrates.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Papers related to this application may be submitted directly to Art Unit 2811 by Facsimile transmission. Papers should be faxed to Art Unit via Tech Center 2800 fax center located in Crystal Plaza 4, Room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh at (703) 305-3410. The examiner can normally be reached on Monday-Friday from 08:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas, can be reached on (703) 308-2772. The fax number for the organization where this application or proceeding is assigned is (703) 308-7722 or 7724.

Nitin Parekh

03-29-03

Steven Loke